
Ebbfleet Central East Outline Planning Application



P e l l F r i s c h m a n n

Ebbsfleet Central East

Drainage Strategy

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Report Ref.		103780-PFC-ZZ-XX-RP-YE-000010-S0-P02				
File Path		\\RSBGUKFS01\LONEngineering\1037--\103780 - Ebbsfleet Central\40 Reports\Drainage\103780-PFC-ZZ-XX-RP-YE-000010-S0-P02.docx				
Suit	Rev	Description	Date	Originator	Checker	Approver
S2	P01	First Issue	01/08/22	K.Ivanov	D.Allum-Rooney	D.Allum-Rooney
S2	P02	Amended as per Client comments and updated to most recent masterplan	21/09/22	K.Ivanov	D.Allum-Rooney	D.Allum-Rooney

Ref. reference. Rev revision. Suit suitability.

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1 Introduction

1.1 Project Brief

- 1.1.1 Pell Fischmann have been commissioned by Ebbsfleet Development Corporation (referred to as the “Client” throughout the document) to provide a Drainage Strategy to support an outline planning application for the development of Ebbsfleet Central East (referred to as the “Proposed Development” throughout the document). Ebbsfleet Central East provides a core component of the Ebbsfleet development area. It is located north of the A2 with Ebbsfleet International Station located within the central area of the site.
- 1.1.2 This report assesses the increase in surface water runoff attributed to the Proposed Development and proposes a surface water management strategy to manage this. The strategy is in accordance with sustainable drainage principles and allows the site to remain free of flooding during design storm events, whilst ensuring no increase of flood risk to offsite receptors and ensures no deterioration of the water environment.
- 1.1.3 In addition to the above, a high level foul water drainage strategy has been included to detail how flows generated from the proposed development will be managed.
- 1.1.4 The report has been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development, published by the Construction Industry Research and Information Association (CIRIA), the British Standards Institution (BSI) BS8533 and the Environment Agency (EA) National Standing Advice on Development and Flood Risk.
- 1.1.5 The outline planning application for Ebbsfleet Central East will be determined by Ebbsfleet Development Corporation (EDC) as Local Planning Authority (LPA) and the Proposed Site also is within the areas of Gravesham Borough Council (GBC), Dartford Borough Council (DBC) and Kent County Council (KCC). KCC is the Lead Local Flood Authority (LLFA) and has the duty to manage local flooding.
- 1.1.6 To complete the Drainage Strategy, the following key stages of work have been undertaken:
- Collation of desk-based information and undertaking a review of publicly available information including local data, policy, and guidance.
 - A desktop review of other data that has been made available such as topographical surveys, utility plans and proposed development layout options.
 - Estimation of the required surface water attenuation storage and provision of outline Sustainable Urban Drainage Systems (SuDS) features arrangement.
 - Outline assessment of viable options for foul flow discharge from the Proposed Development.

1.2 Sources of Information

- 1.2.1 A review of relevant information and guidance from a range of sources has been undertaken and includes the following key documents:
- National Planning Policy Framework (NPPF), April 2022
 - Planning Practice Guidance (PPG), June 2022
 - Environment Agency Flood Map for Planning and Risk of Flooding from Surface Water datasets from the DEFRA Spatial Data Catalogue
 - DEFRA Magic Map, 2022
 - British Geological Survey Geology of Britain Viewer, 2022
 - Kent County Council Drainage and Planning Policy
 - Making It Happen – the Kent Design Guide,

2 Background and Site Context

2.1 Site Location & Existing Use

- 2.1.1 Ebbsfleet Central East is a key component of the Ebbsfleet development area. The Proposed Development is located north of the A2, having Ebbsfleet International Station located at the central area of the site. The location of the site is shown in Figure 2.1.
- 2.1.2 Please note, the red line boundary for this outline planning application should be taken from the submitted Site Location Plan (Drawing Ref: ECE-WAM-XX-XX-DR-A-07-001).
- 2.1.3 Ebbsfleet Central East contains several development areas. The Proposed Development is divided in three development areas – EC1, EC2 and EC6, shown below. EC1 area is approximately 15.44ha, EC2 approximately 13ha and EC6 is approximately 2.5ha. The area within EC6 is designated for open space and there will be no additional impermeable surfaces introduced within its boundary. A site location plan is shown in Figure 2.1.



Figure 2.1 Site Location Plan

- 2.1.4 EC1 is bound by railway tracks from all sides. A226 Thames Way runs north to south through EC1. To the west and northeast EC2 is bound by railway tracks, to the southeast the site is bound by the existing

A2260 Ebbsfleet Gateway and the Ebbsfleet River. Sawyer's (Blue) Lake is further to the southeast of the development site.

- 2.1.5 Currently, three surface car parks are located within the boundaries of both development areas – two within EC2 and one within EC1. A drop off and pick up area and a taxi rank are also within the boundary of EC2. The remaining areas within EC1 and EC2 are currently undeveloped.

2.2 Local Watercourses

- 2.2.1 The Ebbsfleet River flows in a north-easterly direction through EC6. The river then flows north through the EC2 development area, before crossing into EC1. The river divides EC1 into eastern and western parts, before its confluence with The Thames further north (shown in Figure 2.2).

- 2.2.2 The Ebbsfleet River flows along the eastern edge of the A2260 road and is culverted underneath the A226 Thames Way Road and A2260, routing north. It then flows through several other culverts as it routes northwest through EC1 development area. The watercourse then routes northeast, passing through another culvert towards its confluence with The Thames.



Figure 2.2 Watercourse Map

2.3 Topography

- 2.3.1 Both EC1 and EC2 development areas are relatively flat. The railway embankments around EC1 are at a higher elevation than the site area. The levels within the existing car park at EC1 are between 4.2mAOD at the north-western corner and 7.8mAOD at the south-eastern corner of the car park. The highest levels within EC1 are at the south-eastern corner of the development area at around 8.3mAOD. The lowest levels within the EC1 boundary are around 2.1mAOD along the banks of the Ebbsfleet River flowing through the site. Elevations within the EC2 development range from 12.44mAOD at its north-western corner to 2.44mAOD close to the banks of the Ebbsfleet River. The lowest elevations on the existing hard standing car parks are approximately around 5.09mAOD at the south-eastern corner of the car park.
- 2.3.2 The A226 Thames Way road to the east of the site is on an embankment, higher than the adjacent ground levels on site at approximately 6.50mAOD, except for a short section through the valley base where the road runs at grade and shallow cut compared to the surrounding land.
- 2.3.3 The topographical review is based on EA's latest LiDAR data at 1m resolution, and the topographic survey undertaken by Pell Frischmann on 13/07/2020. A preview of the topography, based on LiDAR is shown in Figure 2.3.

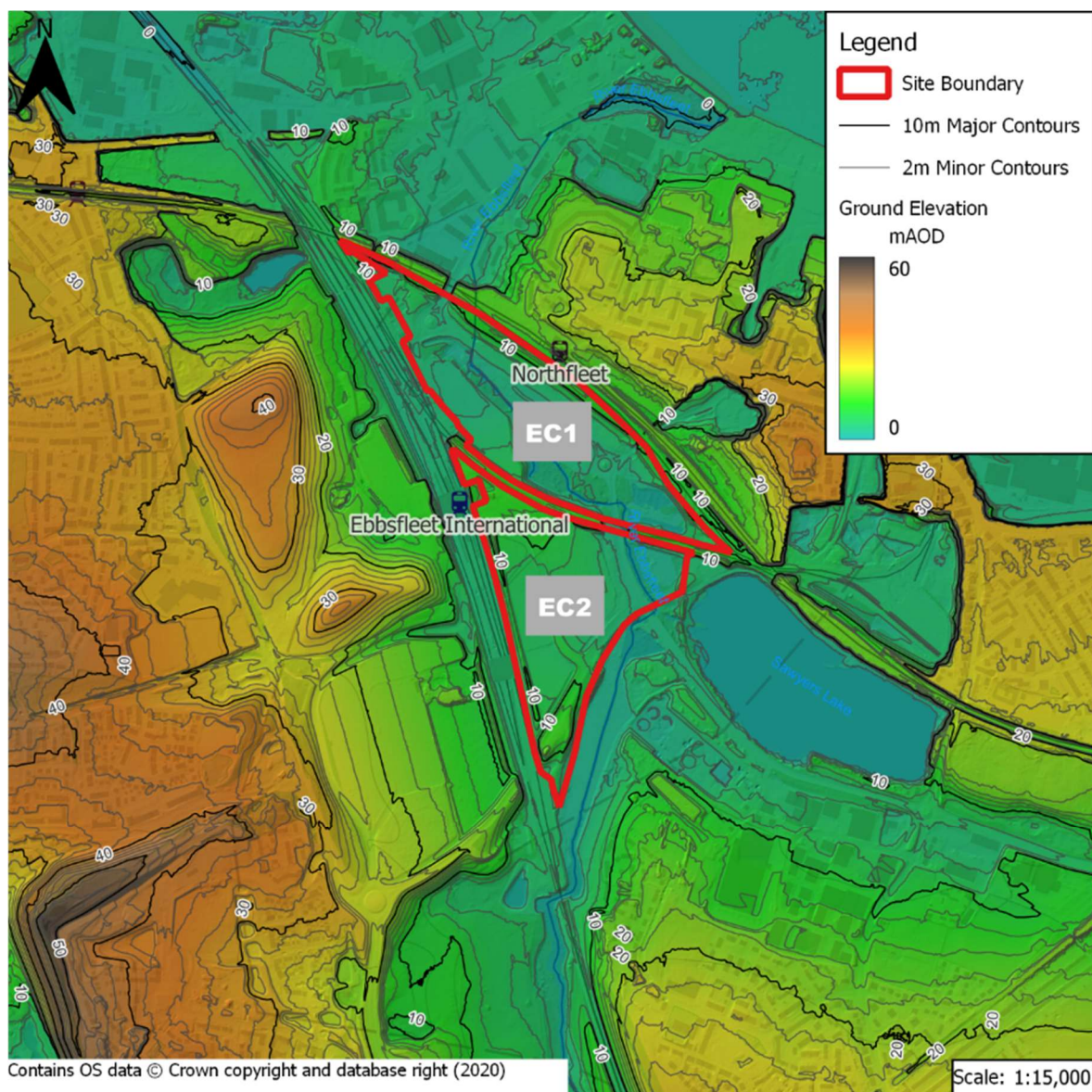


Figure 2.3 Topography within the Proposed Site

2.4 Geology

- 2.4.1 British Geological Survey (BGS) mapping shows that the Proposed Site is underlain by Lewis Nodular Chalk Formation which is sedimentary bedrock of shallow-marine origin. It consists of white chalk with little flint and weakly developed indurated iron-stained sponge beds, typical for the Thanet area of Kent. It is up to 24m thick.
- 2.4.2 The site is underlain by several superficial deposits as shown in Figure 2.4. The majority of the Proposed Development is underlain by Alluvium, present within the floodplain of the Ebbsfleet River. Alluvium is a general term for clay silt, sand and gravel. It is the consolidated detrital material deposited by a river, stream or other body of running water. Head which is poorly sorted and poorly stratified angular rock debris and clayey hillwash is also present within the boundaries of EC1 and EC2.
- 2.4.3 The presence of near surface Chalk has meant that a significant amount of chalk extraction has occurred for the majority of the site. Deep made ground is present due to infilling of historic chalk pits.



Figure 2.4 Underlying Superficial Geology and Borehole Locations

- 2.4.4 BGS holds records for historic boreholes within the site boundary. Details of some of the boreholes are found in Table 2.1, divided by development areas (EC1 and EC2 respectively).

Table 2.1 BGS Borehole Information

BGS Reference	Date bored (mm/yyyy)	Depth (m bgl)	Water struck (m bgl)
EC1			
TQ67SW745	n/a	8.51	Not struck water
TQ67SW815	n/a	11.60	Not struck water
TQ67SW816	n/a	13.70	Not struck water
TQ67SW904	07/1997	7.70	5.5
EC2			
TQ67SW618	06/1994	3.81	Not struck water
TQ67SW856	06/1994	23.65	5.8
TQ67SW747	n/a	15.41	Not struck water
TQ67SW741	05/1994	7.21	4.2

- 2.4.5 Groundwater below the site is likely to drain towards the River Thames.
- 2.4.6 Only several boreholes within the site boundary had water strikes. The recorded depths vary from 4.2m bgl to 5.8m bgl.
- 2.4.7 All borehole records within the site boundary were examined as part of this assessment. Clay was encountered within the majority of the historic boreholes at the Proposed Site, consistent with the presence of alluvium within a large proportion of the site.

3 Policy Context

- 3.1.1 The National Planning Policy Framework (NPPF) was first published in 2012, with a subsequent revision by the Ministry of Housing, Communities and Local Government appended in July 2018 and February 2019 with the most recent update made in July 2021.
- 3.1.2 The NPPF is the primary source of national planning guidance in England, setting out the Government's planning policies for England, and how they are expected to be applied by local councils.
- 3.1.3 The Planning Practice Guidance (PPG) sets out the vulnerability to flooding of different land uses. It encourages development to be in areas of lower flood risk where possible and stresses the importance of preventing increases in flood risk off site to the wider catchment.
- 3.1.4 The Planning Practice Guidance includes a series of tables that define Flood Zones, the flood risk vulnerability classification of development land uses, and 'compatibility' of development within the defined Flood Zones.
- 3.1.5 In addition to addressing the flood risk within a development, it is necessary to ensure that the development does not increase the risk of flooding offsite as a result of an increase in runoff from the development. A surface water management strategy (SWMS) is required to be submitted alongside planning applications.

3.2 Local Policies and Guidance

- 3.2.1 KCC are required to provide technical advice and guidance on the surface water drainage strategies, designs and maintenance put forward by developers for any new major development. As statutory consultees, KCC seek to assist the delivery of requirements of the Government's NPPF.
- 3.2.2 KCC has published a drainage design guidance named Sustainable Drainage – Making it Happen. This guidance encapsulates the principles presented in the Non-Statutory Technical Standards for Sustainable Drainage, produced and issued by Government in 2015. The document summarises:
- KCC's approach to drainage approval and adoption of drainage systems; and,
 - KCC's requirements in how to approach drainage provision within new development

This document is produced in accordance with requirements set out in the Sustainable Drainage – Making it Happen guidance.

4 Proposed Surface Water Drainage

4.1 Sustainable Drainage System (SuDS)

- 4.1.1 To satisfy the requirement of current best national and local flood risk and surface water management guidance, SuDS are required to be incorporated into the design proposals to manage, attenuate and treat surface water runoff before discharging from the site.
- 4.1.2 Current best practice relating to sustainable surface water management is outlined in the SuDS Manual (CIRIA Report C753) which provides details on the use of SuDS for managing surface water runoff.
- 4.1.3 There are four main categories of SuDS which are referred to as the ‘four pillars of SuDS design’ as depicted in Figure 4.1 below.

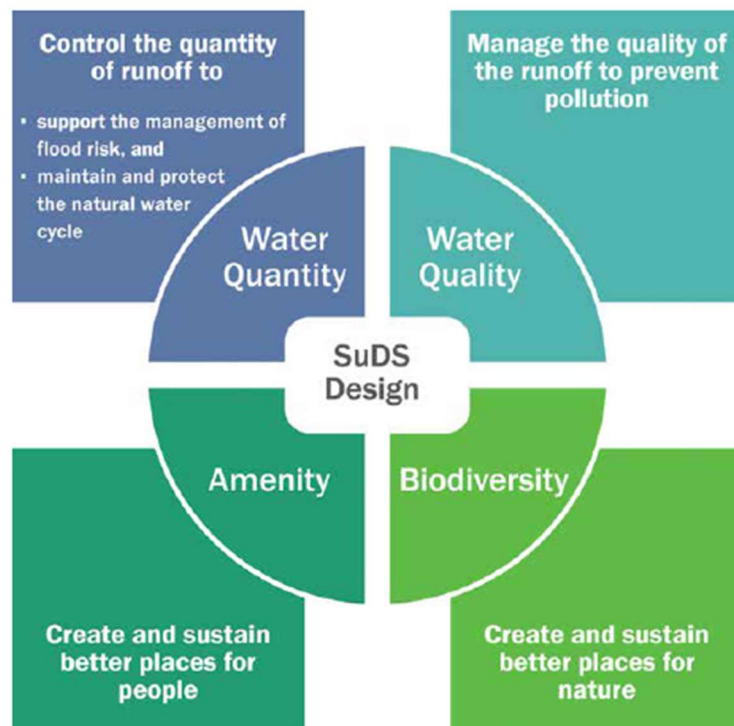


Figure 4.1 The four pillars of SuDS (CIRIA Report C753)

- 4.1.4 The SuDS Manual identifies a hierarchy of SuDS for managing runoff, which is commonly referred to as a ‘management train’:
- Prevention – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
 - Source Control – control of runoff at or very near its source (such as the use of rainwater harvesting, permeable paving or green roofs).
 - Site Control – management of water from several sub-catchments (including routing water from roofs and car parks to one or several soakaways or attenuation ponds for the whole site).
 - Regional Control – management of runoff from several sites, typically in a retention pond or wetland.
- 4.1.5 It is generally accepted that implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:
- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;

- Reducing the volumes and frequency of water flowing directly to watercourses or sewers by removing pollutants from diffuse pollutant sources.
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources.
- Reducing potable water demand through rainwater harvesting.
- Improving amenity through the provision of public open spaces and providing biodiversity and wildlife habitat enhancements.
- Replicating natural drainage patterns, including the recharge of groundwater so that the baseflows are maintained.

4.1.6 The Surface Water Drainage Strategy for the proposed development will comprise the management of surface water runoff from the hardstanding and roof areas. Grassed and landscaped areas within the site will take due consideration of land drainage requirements and overland flow paths.

4.1.7 In accordance with CIRIA Report C753, the hierarchy for favoured disposal of surface water runoff from development sites is as follows:

1. Water reuse, where a demand is identified
2. Infiltration to Ground, where ground conditions permit
3. Discharge to Surface Waters
4. Discharge to Sewer

4.1.8 Table 4.1 below discusses the disposal method suitability in the context of the site and proposed development.

Table 4.1 Suitability of Surface Water Disposal Methods

Surface Water Disposal Method	Suitability Description	Method Suitable (Y/N)
Infiltration to Ground	Based on the established underlying geology, infiltration will not be suitable as a method for surface water disposal since alluvium/clayey deposits have been encountered within the majority of the boreholes within the site.	N
Surface Waters	Surface water runoff from the site can be discharged to the Ebbsfleet River by retaining sections of the existing surface water drainage infrastructure and utilising existing headwalls. Based on the topography, surface water runoff can be discharged at Greenfield, maintaining the natural drainage regime	Y
Sewer Discharge	Connection to public sewer is not viable as no nearby surface water sewers were identified	N

4.2 Drainage Overview

Existing Drainage

4.2.1 Within EC1, 2.2ha are comprised of hardstanding open air car park (currently designated as Car Park C). Site visits and a CCTV survey undertaken by MKSurveys confirms that the car park is drained by a gravity pipe system, discharging to the Ebbsfleet River via two existing headwalls (shown in drawings 103780-PEF-ZZ-XX-DR-CD-0501 and 0502).

4.2.2 Currently, 4.6ha of EC2 are comprised of hardstanding open air car park (designated as Car Park A and Car Park B). Surface water from the hardstanding area is drained through a gravity pipe system and is routed under the A2260 road and discharges to the Ebbsfleet River (as shown on drawing 342-DBJ-03700-13518-Z0 in Appendix B).

4.2.3 The industry-standard Modified Rational Method has been used in the calculation of brownfield runoff rates from existing hardstanding areas (calculation parameters shown in Appendix C). Table 4.2 below summarises existing brownfield runoff rates from the site for the critical storm duration.

Table 4.2 EC1 and EC2 Existing Brownfield Runoff Rates for 2880 min Storm Duration

Impermeable Area (ha)	Brownfield Discharge Rate (l/s)		
	100% AEP	3.33% AEP	0.1% AEP
EC1 - 2.2	6.49	13.74	17.98
EC2 - 5.2	13.57	28.73	37.40

Existing Drainage Infrastructure Capacity

4.2.4 As aforementioned, existing drainage infrastructure will be retained and utilised for disposal of surface water runoff.

4.2.5 A CCTV drainage survey was undertaken within EC1 by MK Surveys (dated 17th June). The surveyors have confirmed the presence of two headwalls, discharging existing surface water runoff to the Ebbsfleet River. The location, size and invert levels of the immediate upstream infrastructure have been surveyed. The downstream slope of the existing pipe has been conservatively assumed as 1 in 300.

4.2.6 The capacity of the existing downstream drainage system has been estimated, using Microdrainage and is found to be 396l/s for the 600mm outlet and 1718.3l/s for the 1050mm outlet (shown in Appendix C).

4.2.7 According to drawing 342-DBJ-03700-13518-Z0 (shown in Appendix B), there is an existing surface water drainage run along the eastern edge of the A2260 road that discharges to the Ebbsfleet River through a headwall at junction between A2260 and A226 roads. The location of the headwall is confirmed within the topographic survey (shown in Appendix D).

4.2.8 It is proposed that the surface water drainage network from EC2 ties into the existing manhole 3SA-12 (as per drawing 342-DBJ-03700-13518-Z in Appendix B).

4.2.9 The capacity of the existing network, downstream of 3SA-12 has been calculated in Microdrainage and is estimated to be 127.9l/s (shown in Appendix C).

Proposed Surface Drainage

4.2.10 Taking Table 4.1 into account, it is proposed that controlled surface water runoff from the EC1 and EC2 development areas is discharged via a piped gravity sewer network at greenfield runoff rates, retaining some of the existing drainage infrastructure and headwalls discharging to the Ebbsfleet River (shown in drawings 103780-PEF-ZZ-XX-DR-CD-0501 and 0502).

4.2.11 Taking into account current best practice for surface water management and SuDS Design (CIRIA Report C752) it is proposed to limit surface water discharge from the Proposed Development to the mean annual peak flood (i.e. QBAR) rate of runoff, thus controlling the 'peak' discharge and discharge volume for all storm events up to and including the design 1:100 year with 40% climate change uplift event.

- 4.2.12 Greenfield runoff rates have been estimated through application of methodology outlined in IH124 as set out within the Interim Code of Practice for SuDS (ICPSuDS). The IH124 method can be used to estimate Greenfield runoff rates for a range of Annual Exceedance Probability (AEP) events, or return periods by applying regional growth curve factors to the mean annual peak runoff (i.e. QBAR). The UK hydrological region for the Proposed Site is Region 7, therefore the appropriate growth curve factors for this region have been incorporated into the analysis undertaken in the MicroDrainage software suite.
- 4.2.13 The Ebbsfleet River divides EC1 in two areas. For the purpose of the drainage strategy and assessing impermeable areas and surface water discharge, these are referred to 'EC1 West' and 'EC1 East' within this report. The proposed area to be developed within EC1 West is approximately 2.45ha, EC1 East is 2.47ha and EC2 is approximately 7.46ha.
- 4.2.14 The hydrological characteristics for the catchment have been incorporated into the runoff modelling and results are presented below in Table 4.3 for a range of AEP storm events.
- Total Site Area: EC1 west - 2.45ha, EC1 east - 2.47ha, EC2 – 7.46ha
 - Average Annual Rainfall (SAAR): 569mm/year
 - Soil Index: 0.400
 - UK Hydrological Region No.7
 - Urban Extent 0

Greenfield runoff modelling results are presented below in Table 4.3 for a range of AEP storm events, based on the proposed impermeable development footprint. It is assumed that 100% of the developed area of EC1 and 90% of the developed area of EC2 will consist of impermeable areas.

Table 4.3 Estimation of Greenfield (pre-development) Rate of Runoff

AEP (%)	Return Period	Greenfield Runoff Rate (l/s/ha)
50	2	2.4
	QBAR	2.7
3.3	30	6.1
1	100	8.5
0.5	200	10
0.1	1000	13.8

- 4.2.15 The QBAR 'Unit Greenfield Runoff Rate' for the Proposed Site, and thus the limiting post development peak runoff rate for all storm events up to and including the design 1% AEP plus climate change, has been estimated to be 2.7l/s/ha.
- 4.2.16 Therefore, the Greenfield runoff rate for EC1 West is **6.5l/s**, for EC2 East – **6.6l/s** and for EC2 is **19.9l/s**.
- 4.2.17 The latest guidance on climate change impacts on peak rainfall intensities has been published by the Environment Agency, with an updated approach based on regional estimates across river management catchments. The site falls within the Medway Management Catchment, which suggests for the 2070s epoch the upper end climate change allowance is 40%. The climate change allowance is determined in accordance with Kent County Council's guidance.
- 4.2.18 In accordance with CIRIA Report C752, it is necessary to undertake a 'Water Quality Risk Management' assessment to determine the suitability of SuDS methods from a water quality perspective. The approach outlined below is based on the 'Simple Index Approach' for groundwater and surface water as detailed in the SuDS Manual (Section 26.7).

- 4.2.19 Table 4.4 below compares the SuDS Mitigation Indices against the Pollution Hazard Indices for the development. This is based on the application of a 'site control' strategy to manage post development runoff from the Site.

Table 4.4 SuDS Water Quality Design Criteria: Index Approach Review

Land Use	Pollution Hazard Indices		
	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Residential roofs	0.2	0.2	0.05
Commercial/Industrial roofing with low potential for metal leeching	0.3	0.4	0.05
Residential parking	0.5	0.4	0.4
Low traffic roads	0.5	0.4	0.4
Treatment	Mitigation Indices		
	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Pervious pavement	0.7	0.6	0.7
Bioretention system (rain gardens)	0.8	0.8	0.8
Proprietary treatment system if required (values based on Klargestar AquaTreat Surface Water Treatment separator)	0.8	0.64	0.99

- 4.2.20 The SuDS Mitigation Index offered by the proposed SuDS is greater than the Pollution Hazard for all treatment options, therefore the water quality assessment criteria are satisfied.
- 4.2.21 The arrangement of the surface water treatment measures within the surface water network will be confirmed within the detailed design stage of the project.

4.3 Proposed Attenuation and SuDS Features

- 4.3.1 Given the spatial masterplaning constraints, it is proposed that attenuation for EC1 and EC2 is achieved through geocellular underground storage system along with one SuDS pond within EC1, used as a 'site control' strategy to manage post development runoff from the site.
- 4.3.2 In accordance with CIRIA Report C753 it is necessary to undertake a 'Water Quality Risk Management' assessment to determine the suitability of SuDS methods from a water quality perspective. This is not undertaken at this high-level drainage assessment but should be considered at further stages of the development of the Proposed Site.

- 4.3.3 The two proposed geocellular storage and SuDS attenuation pond have been modelled within the industry standard MicroDrainage Source Control (calculations provided in Appendix C) software to demonstrate the layout and provisional design details (subject to final site levels) are sufficiently sized and that surface water attenuation is feasible within the proposed site layout. The key design parameters for the proposed SuDS basins are detailed in Table 4.5 below.

Table 4.5 Pond Summary Design Details

Parameter	Unit	EC1 West	EC1 East	EC2	Notes
Total contributing impermeable area	ha	2.447	2.468	7.456	Based on current masterplan
Limiting discharge rate	l/s	6.5	6.6	19.9	To be provided by HydroBrake Optimum unit or similar approved
Total storage volume required for 1% AEP + 40% CC (2880 min storm duration)	m ³	2608	2626	7910	Calculated through MicroDrainage
Geocellular storage volume for 1% AEP + 40% CC	m ³	2418	2626	7910	Based on the proposed site layout
Proposed SuDS Pond Volume	m ³	190	-	-	Based on the proposed site layout

- 4.3.4 It should be noted that the outline drainage design proposed in this section provides high-level assessment of the required attenuation storage based on assumed development impermeable surfaces. The proposed SuDS basins are not based on proposed site levels and are indicative only.
- 4.3.5 In indicative attenuation tanks and SuDS pond layout is shown in drawing 103780-PEF-ZZ-XX-DR-CD-0501 and 0502. The SuDS pond is designed to be 1.5m deep with 1:4 side slopes with permanent water level of 0.5m. An emergency spillway to Ebbsfleet River is also provided.

Comparison between existing and proposed discharge rates to the Ebbsfleet River

- 4.3.6 Attenuating the 1%AEP event with 40% uplift for climate change and limiting discharge to Greenfield runoff will provide a substantial betterment to existing conditions. The discharge flows are compared in Table 4.6 below.

Table 4.6 Brownfield Runoff Rate for the Existing Development

Parameter	Unit	EC1 West	EC1 East	EC2	Notes
Brownfield Runoff Rate (1% AEP)	l/s	17.98	(Greenfield)	37.40	Calculated with the Modified Rational Method
Post development runoff rate (1% AEP)	l/s	6.5	6.6	19.9	Calculated in MicroDrainage

- 4.3.7 The outline drainage design follows recommendations by KCC and EA made at pre-application design workshops with Pell Fischmann. The drainage design is adhering to the design guidance provided by KCC and including a SuDS pond with 0.5m permanent water level. The side slopes are 1:4. It is also recommended that the pond is lined to prevent seepage.

5 Outline Foul Water Drainage

5.1 Overview

- 5.1.1 Southern Water's asset plans (shown in Appendix A) indicate an existing foul rising main and a foul gravity sewer within the Proposed Site boundary. The existing rising main and foul sewer will be diverted within the detailed design stage.
- 5.1.2 The two existing foul rising main and gravity sewer crossing the Proposed Site convey foul flows to the nearby Northfleet Wastewater Treatment Works (WWTW).
- 5.1.3 From initial review of the available information, gravity connection to existing foul sewer is viable for the entire site. The existing foul rising main and foul gravity sewer crossing through the site will be diverted within the detailed design stage of the project.
- 5.1.4 There are two development scenarios for the proposed site. One of the scenarios consists of 1795 residential dwellings for both EC1 and EC2 while the second scenario consists of 2728 dwellings. Both options have additional hotel, retail, and office space. The total population equivalent (p.e.) is calculated, based on "Codes of Practice Flow and Loads – 4 (2013)". The peak flow from the residential dwellings is calculated, based on the Design and Construction Guidance for Foul and Surface Water Sewers (shown in Table 5.1).

Table 5.1 Summary of Discharge Rate Calculation for Residential Dwellings

Parameter	Units	EC1 & EC2 Combined	Notes
Development Scenario 1			
Dwellings	No. houses	1795	Based on the proposed masterplan configuration and assumptions from "Codes of Practice Flow and Loads – 4 (2013)"
Peak Loading	l/s	89.75	Based on Design and Construction Guidance for foul and surface water sewers offered for adoption
Development Scenario 2			
Population Equivalent	No. persons	2728	Based on the proposed masterplan configuration and assumptions from "Codes of Practice Flow and Loads – 4 (2013)"
Peak Loading	l/s	136.4	Based on Design and Construction Guidance for foul and surface water sewers offered for adoption

- 5.1.5 Once the final development scenario is confirmed and the population equivalent within the commercial part of the development is established, the total loading to the foul system should be calculated. A pre-development enquiry should be undertaken with Southern Water who will confirm whether their network and WWTW has the capacity to accommodate the additional foul flows.
- 5.1.6 The layout should either consider suitable landscaped corridors around the current sewer alignments with appropriate stand offs, otherwise the foul sewers will need to be diverted as part of a S185 application process with Southern Water to accommodate them within the proposed layout.

6 Surface and Foul Water Drainage Maintenance Plan

6.1 Overview

- 6.1.1 To ensure the proposed surface water and foul water management strategies perform at its design operation requirements, drainage components should be inspected and maintained throughout the life of the development. Regular inspection / maintenance will ensure efficient operation and prevent potential failure of drainage components.
- 6.1.2 The following draft maintenance plan has been developed from best practice guidance, information provided in the CIRIA Report C753 and manufacturer's guidelines.
- 6.1.3 The draft maintenance schedule will be integrated into the overall site operating and maintenance strategy and tailored / refined over time.

6.2 Maintenance Program

- 6.2.1 Table 6.1 below provides the inspection and maintenance recommendations set out in Table 22.1 of the CIRIA Report C753.

Table 6.1 SuDS Maintenance Requirements

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly
	Cut the meadow grass	Half yearly
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, pipework for evidence of blockage and damage	Monthly
	Inspect for signs of poor water quality	Monthly
	Inspect silt accumulation	Half yearly
	Inspect outlet and Hydrobrake manhole for debris / blockages	Monthly
	Hand cut submerged and emergent aquatic plants	Annually
	Remove 25% of bank vegetation from water's edge	Annually
	Tidy dead growth before start of growing season	Annually
Occasional Maintenance	Remove sediment from the main body of pond	As required (likely only every 25-50 years with effective pre-treatment)
Remedial Actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond if signs of eutrophication are detected	As required
	Repair inlets or outlets	As required

- 6.2.2 Regular inspection and maintenance are required to ensure the effective long-term operation of below-ground storage systems. Table 6.2 provides guidance on the type of operational and maintenance

requirements that may be appropriate. Maintenance plans should be developed during the detailed design phase and will be specific to the type of tank that is adopted.

Table 6.2 Geocellular Storage Maintenance Requirements

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly or 3 months
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter- remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually
Remedial Actions	Repair / rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	As required or every 5 years

7 Conclusions & Recommendations

7.1.1 Summary of outline drainage strategy for the site:

- The assessment of existing drainage regime of EC1 and EC2 indicated that 2.2ha of EC1 and 5.2ha of EC2 are hardstanding impermeable areas that drain through gravity pipe systems and headwalls to the Ebbsfleet River. The rest of the area is undeveloped .
- No infiltration testing has been undertaken within the existing site ground investigation surveys, however based on the underlying strata, and available borehole information, infiltration is not deemed feasible due to the clay soils and chalky deposits.
- Review of Southern Water infrastructure indicated there are no surface water sewers near the Proposed Site.
- The most viable option for surface water disposal from the Proposed Site is to the Ebbsfleet River, retaining some of the existing drainage infrastructure and headwalls. The estimated limiting discharge (Greenfield runoff) for EC1 is 13.1l/s (combined for both areas of EC1) and 19.9l/s for EC2, assuming introduction of 90% impermeable area within a future proposed development of both areas.
- The proposed site is spatially constrained and in its existing brownfield use does not provide any flow attenuation. It is proposed that surface water flows are attenuated to 1%AEP + 40% climate change uplift. Attenuation storage for the site is proposed to be provided through a system of geocellular underground storage and a SuDS pond within EC1.
- Outline design was undertaken for EC1 and EC2. The required storage volume within EC1 is 5234m³. The SuDS pond storage volume within EC1 is 510m³, the rest of the storage is provided by geocellular storage. Attenuation storage volume for EC2 is 7910m³, provided by underground geocellular storage.
- Surface water will be discharged to the Ebbsfleet River through three existing headwalls (2 in EC1 and 1 in EC2). Additional three headwalls are proposed for the eastern part of EC1 which is currently greenfield.
- A rising foul main, and a gravity foul sewer are located within the site boundary. Both are discharging to Northfleet WWTW. The existing rising main, and gravity foul sewer will be diverted within the detailed design for the site. The gravity sewer is deemed to be the most feasible option for discharge of foul flows from the site.

Do we need an overall conclusion here e.g. this strategy demonstrates that appropriate drainage for the site can be achieved in line with national and local planning policy and guidance?

7.1.2 Recommendations for Detailed Design:

- The number of flow controls and their placement will be optimised within the detail design stage of the site, considering the proposed ground levels.
- Consideration will need to be given to the rising foul main and the gravity foul sewer crossing the site, and they should be diverted within the detailed design stage.
- The loading to the proposed foul sewer should be reassessed, once the final development scenario is confirmed.
- The existing headwalls and access to them should be cleared of vegetation and a comprehensive CCTV survey should be undertaken for the entire surface water drainage network within the open-air car parks to inform detailed design.

Appendix A Southern Water Asset Plan & CCTV Survey

Appendix B 'AS BUILT' Drawings

Appendix C Microdrainage Calculations

Appendix D Topographic Survey